Space Weather Technical Forecast

Issued on Saturday, 16 July 2022 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: R1-R2 Likely. Active electron fluence likely by Days 3 and 4 (18-19 July).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low in the past 24 hours, with numerous C-class flares, and background x-ray flux in the C-class category. There are currently seven sunspot regions on the visible disc, many of which are large and mature, although the magnetic structure of most of them is fairly straightforward.
There are also several large filaments on the visible disc, one of which in the NW quadrant erupted between 15/1300-1600 UTC. It appears to have produced a partial halo CME in coronagraph imagery, although there are limited images with which to assess this CME at the present time. It is slow, although as a filament eruption it is likely quite dense, and is not expected to reach Earth until late on 19 July or on 20 July. No other Earth directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has been elevated over the past 24 hours, likely the result of coronal hole high speed stream influences. The speed was elevated throughout, mostly varying between 540-580 km/s. The density was above average between 10-13 ppcc. The IMF was mostly weak, with the north-south component varying between +4/-7 nT, but mostly southward directed. The phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, was at Background levels.
The high energy electron flux (greater than 2 MeV) was predominantly Moderate, peaking at 951pfu at 15/2325 UTC. The corresponding 24-hour integrated electron fluence remained well below the Active (1e8 integrated pfu) threshold. The observed fluence at 16/0001UTC was 1.03e7 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is Likely to be Moderate, with a daily Slight Chance of X-class flares. Two of the current large sunspots should leave the Earth-facing side on Days 3 and 4 (18-19 July), resulting in a slight reduction in flare probability. Arriving bright flux over the eastern limb may compensate for any loss, however.

Solar Wind / Geomagnetic Activity: A filament eruption appears to have produced a partial halo CME. There are limited images with which to assess this CME at the present time but it appears slow, and is not expected to reach Earth until until late on 19 July or on 20 July. Otherwise, solar winds are expected to slowly decline to near background levels through Days 1 and 2 (16-17 July). A further HSS from CH03/- is likely to give wind speeds up to 450-500 km/s, most likely on Day 4 (19 July).
Geomagnetic activity is expected to be mostly Quiet, perhaps with the odd Unsettled interval on Day 1. The HSS from CH03 may give an increase on Day 4 to Unsettled, perhaps Active levels.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

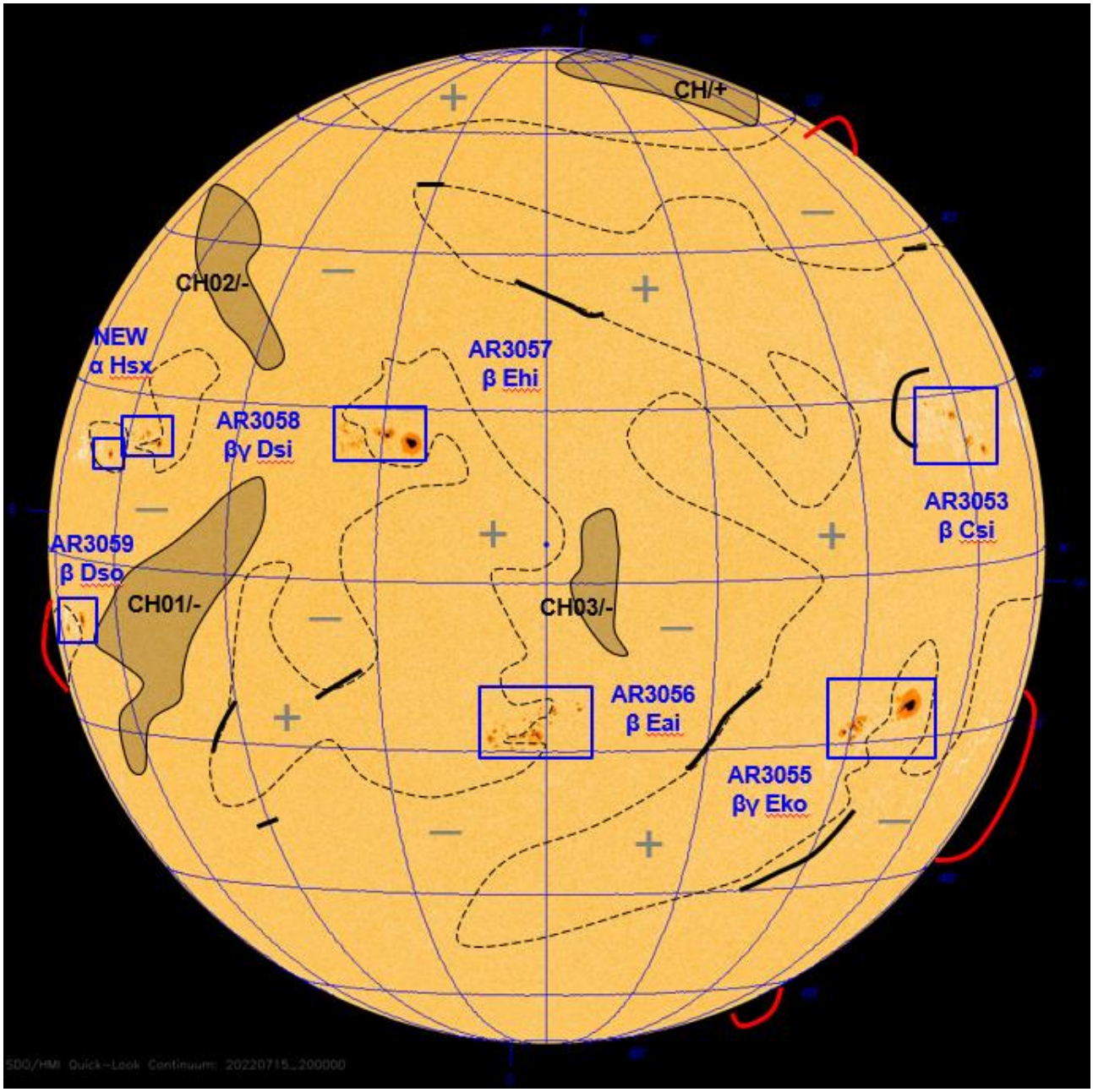
The CME as mentioned above is unlikely to arrive until after the end of Day 4, but may give G1/Minor Storm intervals.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at Background levels, but with a daily Slight Chance of S1 or greater due to the presence of large sunspot regions in the west or near centre disc.
The high energy electron flux (greater than 2 MeV) is expected to increase over the coming days, with diurnal maxima likely to exceed the High (1e3 pfu) threshold. Fluence levels are also expected to increase, with Active (1e8 integrated pfu) fluence likely by Days 3 and 4 (18-19 July).

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 1. Solar Analysis Valid 15/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

A filament in the NW quadrant erupted between 15/1300-1600 UTC. It appears to have produced a partial halo CME in coronagraph imagery, although there are limited images with which to assess this CME at the present time. It is very slow, although as a filament eruption it is likely quite dense, and is not expected to reach Earth until late on 19 July or on 20 July.

Solar winds are expected to slowly decline to near background levels through Days 1 and 2 (16-17 July) due to waning HSS influences. A further HSS from CH03/- is likely to give a renewed increase in wind speeds, perhaps to 450-500 km/s, most likely on Day 4 (19 July). Geomagnetic activity is expected to be mostly Quiet, perhaps with the odd Unsettled interval on Day 1. The HSS from CH03 may give an increase on Day 4 to Unsettled, perhaps Active levels. The CME as mentioned above is unlikely to arrive until after the end of Day 4, but may give G1/Minor Storm intervals.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	1	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

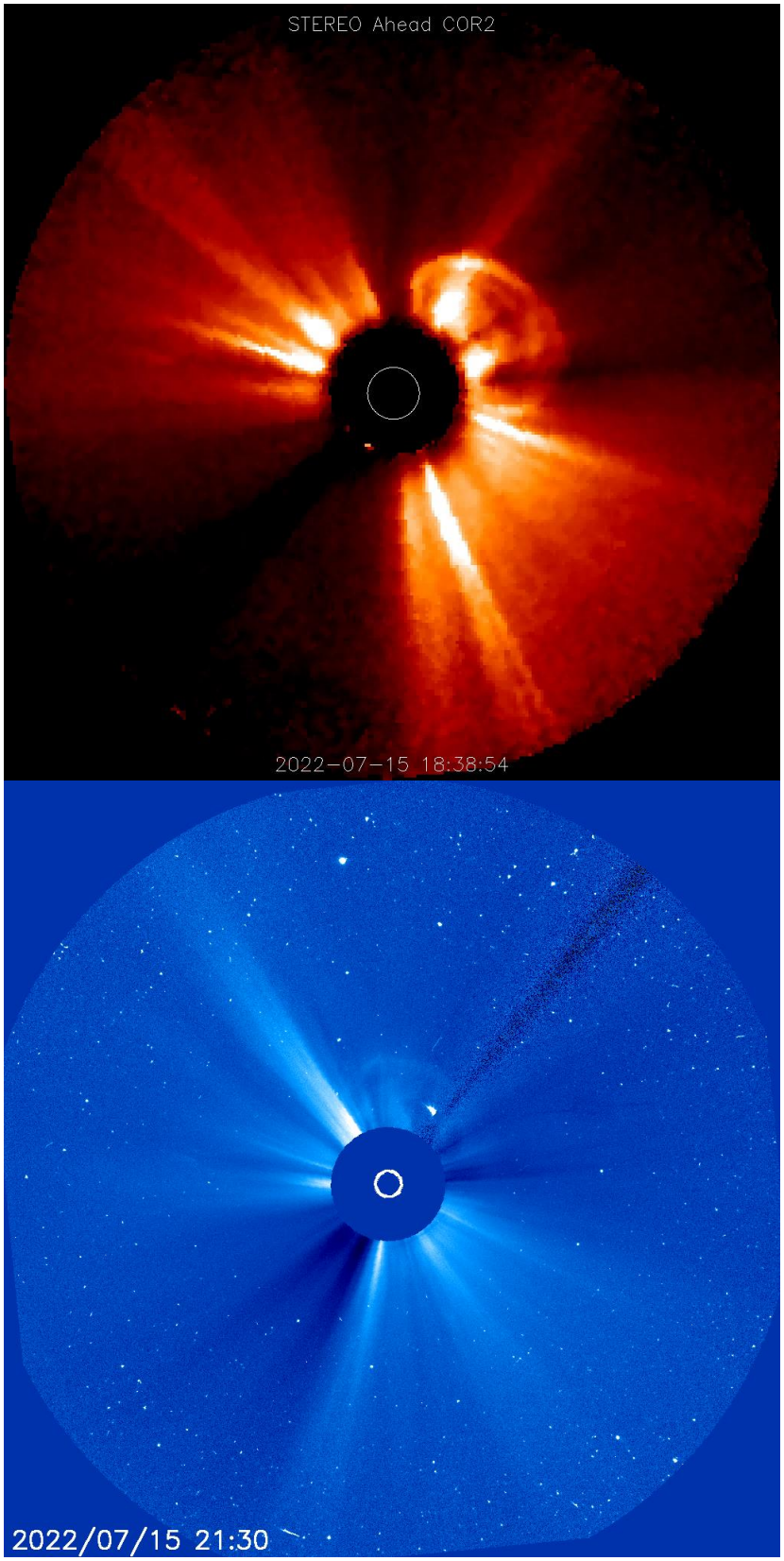
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0209	Partial	Filament eruption	NW quadrant	395 km/s	20/0600 UTC	Not yet fully modelled, but arrival is most likely early 20 July.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 2: Coronagraph imagery from STEREO-A (above) and SOHO (below) showing the CME associated with a filament eruption. This is most likely to arrive at Earth early on 20 July.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

Solar activity has been Low during the last 24 hours, however M-class events are Likely. There are currently seven sunspot regions on the visible disc. AR3053 (Csi/Beta) has been re-classified as a C group with the trailing spots fading significantly. AR3055 (Eko/Beta-gamma) is showing a slight increase in magnetic complexity. AR3057 (Ehi/Beta) showed some additional trailing spots. AR3058 (Dsi/Beta-gamma) showed little change, although the trailing Hsx/Alpha region appears to be a separate spot from 3058 and has been analysed as a separate NEW region. AR3056 (Eai/Beta) and AR3059 (Dso/Beta) showed little change.

Considering the overall balance of sunspot groups, two regions are due to leave the disc on Days 3 and 4 (18-19 July). This results in a slight decrease in the probability of flaring towards the end of the period. Arriving bright flux over the eastern limb may compensate for any loss, however this will be assessed as and when this region arrives over the northeastern solar horizon.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	60	60	50	40
Very Active	R3 to R5 X Class	No	10	10	10	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels. Owing to the complexity of the current disc, and in particular several large regions in the west or near centre disc, there is a daily Slight Chance of S1 or greater occurring.

Sub-S1 events of the past week were tied to a feature (Ex-3047) that is now long since past its peak geoeffective location (being several days onto the far side), and none of the present front-side sunspots have any history of any proton enhancement so far.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

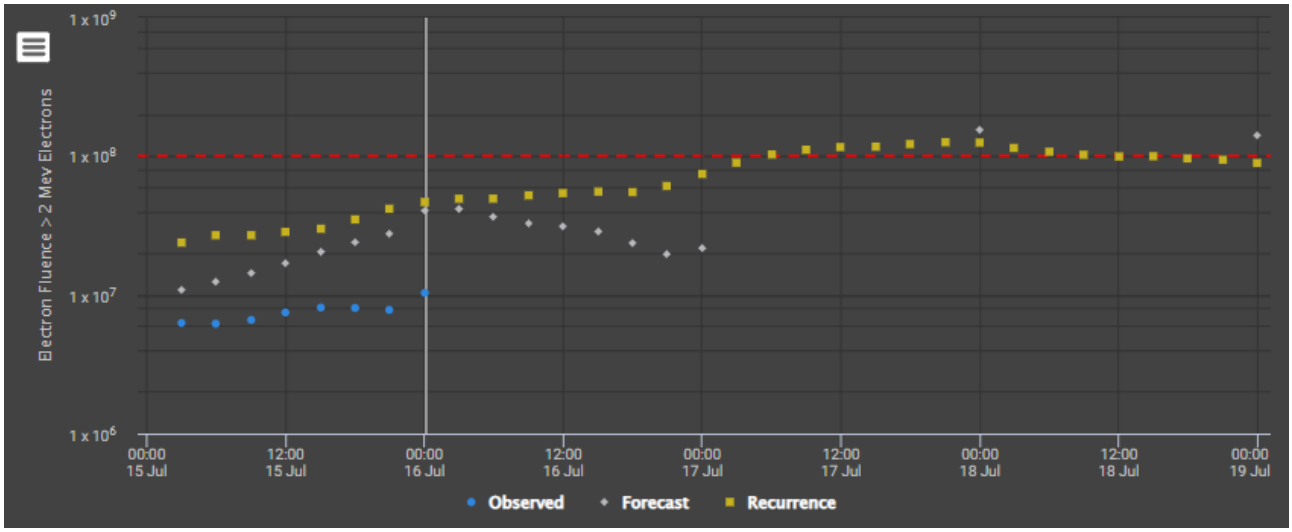
© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
The diurnal variation in high energy electron flux (greater than 2MeV) is currently peaking at Moderate levels. The elevated solar wind speed ought to give an increase in flux over the coming days. Persistence from the last rotation is offering a reasonable match, which also suggests that an increase is likely. An anticipated CME arrival is unlikely to arrive until after this four day period, so any CME suppression is expected to be after the forecast period, although undetected CMEs are always possible given the numerous sunspots and filaments on the disc.

Fluence is expected to rise during this period, with Active (1e8 integrated pfu) becoming likely by Days 3 and 4 (18-19 July). REFM's increasing fluence signal currently seems reasonable.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	50	70	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM model showing a rising fluence trend, which seems reasonable.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.